Docket No.: 1422-0678PUS1

(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
Mikio SAKAGUCHI et al.

Application No.: 10/537,833 | Confirmation No.: 8685

Filed: June 8, 2005 | Art Unit: 1793

For: SPHERICAL CASTING SAND | Examiner: K. P. Kerns

DECLARATION UNDER 37 C.F.R. § 1.132

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

I, Mikio SAKAGUCHI, declare the following:

I have read and understood the specification and claims to the above-identified application and the outstanding Office Action of July 8, 2009 (hereinafter "Office Action").

I have also read and considered the references cited therein as the basis of the obviousness rejection under 35 U.S.C. §103(a) as being unpatentable over Kobayashi et

al. (U.S. Patent No. 6,054,073) (hereinafter "Kobayashi") in view of the publication to IMONO "Application of Mullite Ceramic Beads to Mold Sand" in the Journal of the Japan Foundrymen's Society, 1992 (hereinafter "IMONO").

The present invention greatly differs from the teachings of Kobayashi and IMONO in that the originally filed specification gives the surface texture and water absorption clearly distinguishable from those of IMONO, as clearly shown in data attached.

I. EXPERIMENTAL PROCEDURES

1. Process for Producing Spherical Molding Sand

1) Additional Example A

The same procedures as in Example 1 were carried out, using as a starting material a calcined mullite powder containing 96.6% by weight of Al_2O_3 and SiO_2 in a total amount and having an Al_2O_3/SiO_2 weight ratio of 1.82, an average particle size of 0.22 mm, a major axis diameter/minor axis diameter ratio of 1.4, and a water content of 0.9% by weight, to give a monodispersed spherical molding sand. The resulting molding sand contained 96.3% by weight of Al_2O_3 and SiO_2 in a total amount and had an Al_2O_3/SiO_2 weight ratio of 1.8, an average particle size of 0.21 mm, a spherical degree of 0.99, and water absorption of 0.04% by weight.

2) Additional Example B

The same procedures as in Example 1 were carried out, except that powdery particles containing 97% by weight of Al_2O_3 and SiO_2 in a total amount and having an

average particle size of 0.23 mm, a major axis diameter/minor axis diameter ratio of 1.8, and a water content of 2.1% by weight, in which the powdery particles were prepared by mixing aluminum hydroxide with kaolin so as to have an Al_2O_3/SiO_2 weight ratio of 1.84 and calcinating the mixture in an electric furnace at 700°C for 1 hour, was used as a starting material, to give a monodispersed spherical molding sand. The resulting molding sand contained 97% by weight of Al_2O_3 and SiO_2 in a total amount and had an Al_2O_3/SiO_2 weight ratio of 1.8, an average particle size of 0.21 mm, a spherical degree of 0.99, and water absorption of 0.10% by weight.

3) CERABEADS #650

CERABEADS #650 is commercially available from Itochu Ceratech Co. CERABEADS #650 is one example of mullite ceramic beads listed in IMONO.

2. METHODS OF EVALUATION

Water absorption, spherical degree, pulverization resistance, strength of mold, and surface texture of spherical molding sand of each molding sand were evaluated as follows.

(i) Water Absorption

The water absorption can be measured by the water absorption measurement method for fine aggregate of JIS A1109. The results are shown in Table I.

(ii) Spherical Degree

The spherical degree is obtained by the following method: The photograph image of the particle is taken by the digital scope (VH-8000, manufactured by KEYENCE.Co). The image taken was subjected to image analysis to obtain an area of particle projected section of the particle and a peripheral length thereof, followed by calculation of [peripheral length (mm) of complete round having the same area as the area (mm^2) of particle projected section] / [peripheral length (mm) of particle projected section], and then by averaging respectively obtained values selected from optional 50 spherical molding sand particles.

(iii) Pulverization Resistance

The pulverization resistance was evaluated in the same manner as in Test Example 3 of the present specification. Specifically, the pulverization resistance, which is an indicator for regeneration efficiency of molding sand, was compared between the molding sands obtained in Examples shown in Table 1. One kilogram of molding sand was supplied to an alumina ball mill, and treated for 60 minutes. Thereafter, change of the average particle size [(average particle size before treatment/average particle size after treatment) × 100] was used as an indicator for the pulverization resistance. The smaller the change is, the more excellent the pulverization resistance is. The results are shown in Table I.

(iv) Strength of Mold

The strength of the mold was evaluated in the same manner as in Test Example 1(2) of the present specification. Specifically, molding sand was classified into particles

having a size of 74 to 250 μm. Thereafter, 0.5 parts or 1.5 parts by weight of Kao LIGHTNER 340B (commercially available from Kao-Quaker Co., Ltd.) were added as a molding binder to 100 parts by weight of the molding sand, and the resulting mixture was molded into a mold (diameter: 50 mm × height: 50 mm) according to a self-hardening molding method. Subsequently, the mold was stored at room temperature for 24 hours, and thereafter the compressive strength (MPa) of the mold was determined (25°C, humidity: 55%). The results are shown in Table I.

(v) Surface Texture of Spherical Molding Sand

The surface texture of each spherical molding sand was judged based on photographs taken with a scanning electron microscope.

3. RESULTS

Table I

	Ex. 3 of the present invention	Additional Example A	Additional Example B	CERABEADS #650	Comp. Ex. 1 of the present invention
Water Absorption (%)	0	0.04	0.1	0.45	1.2
Al_2O_3/SiO_2	2.7/1	1.8/1	1.8/1	1.7/1 *1	2.7/1
Average Particle Size (mm)	0.21	0.21	0.21	0.20	0.18
Spherical Degree	0.99	0.99	0.99	0.98	0.89
Total Amount (Al_2O_3/SiO_2) (% by wt)	98	96.3	97	96.9	97
Production Process	Flame Fusion Method	Flame Fusion Method	Flame Fusion Method	Spray-Drying, Calcination	Spray-Drying, Calcination
Pulverization Resistance	119	117	122	131	129
Strength (MPa) of Mold When Changing Amount of Binder					
Amount of Binder: 0.5%	Not measured	5.5	3.4	0.8	Not measured
Amount of Binder: 1.5%	Not measured	Not measured	Not measured	4.2	Not measured

*1 Calculated from a composition (60.38/36.50) in *IMONO*.

FIG. A

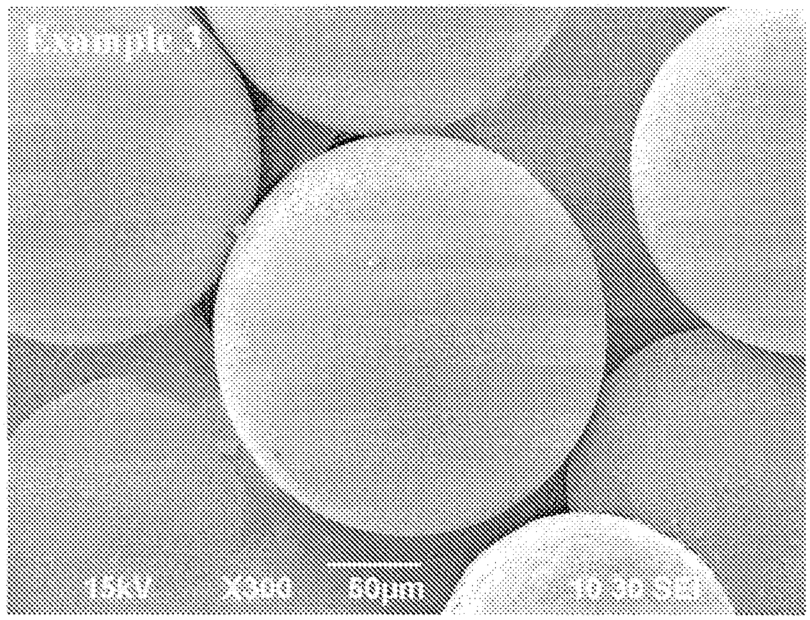
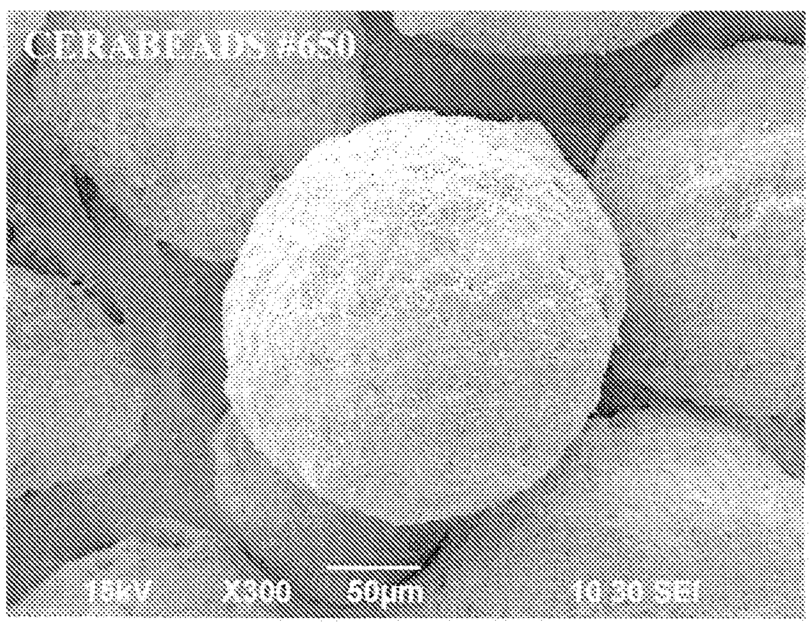

Example 3
15kV X300 50µm 10 30 SEI

FIG. B


CERABEADS #650
15kV X300 50µm 10 30 SEI

4. DISCUSSION

To begin with, the spherical molding sand of IMONO and the spherical molding sand of the present invention are different in the production processes. Moreover, it can be seen from the above results the structure and the physical properties of the resulting product molding sand are different from each other, and further that the effects exhibited thereby are different from each other. The details are given hereinbelow. In order to evaluate more appropriately, the spherical molding sands of Additional Examples A and B of which Al_2O_3/SiO_2 ratio approximates that of CERABEADS are added for exact comparison with CERABEADS described in IMONO.

The molding sand of the present invention is produced by flame fusion method, in which raw material ceramic particles are fused in the flame to produce spherical particles (see page 12, line 5 to 9 of the specification). On the other hand, the molding sand of IMONO is produced by spray-granulating into a spherical form, and subjecting a granulated product to a high-temperature baking with a rotary kiln [IMONO, page 562, the section of 2.1 Manufacturing Process].

It is evident from the above photographs showing the surface textures of both the molding sands that since the molding sands are produced by different production processes, the surface texture is different, and the molding sand of the present invention has a high spherical degree and is compact (see FIG. A (upper panel) of this Declaration, page 7, line 3 to 7 of the specification). On the other hand, the molding sand of IMONO has voids (see FIG. B (lower panel) of this Declaration). The difference in the texture caused by the production process is reflected in the difference in water absorption.

It is verified in Table I that the molding sand of the present invention has a water absorption of at most 0.3% (in Examples, 0%, 0.04% and 0.1%), while CERABEADS #650 shown in IMONO has a water absorption of 0.45%.

It can be seen from Table I that if the molding sand has a low water absorption, the surface is compact, so that the molding sand itself has a high strength, thereby improving the strength of the mold (see page 7, line 21 to page 8, line 2 of the specification). In addition, when the molding sand is regenerated, since the molding sand has pulverization resistance, the regeneration efficiency also becomes high (see Test Example 3, Table 3).

It can be seen in Table I that the molding sand of Example 3 (water absorption: 0%), the molding sand of Additional Example A (water absorption: 0.04%), and the molding sand of Additional Example B (water absorption: 0.10%), each having a water absorption of at most 0.3%, have excellent pulverization resistance, as compared to CERABEADS #650 (water absorption: 0.45%) and Comparative Example 1 (water absorption: 1.2%), each having a water absorption exceeding 0.3%.

In addition, Table I also verifies that if the water absorption is low, the amount of the binder absorbed to the internal of the molding sand is suppressed, so that a high strength in the mold is exhibited with a smaller amount of a binder (see page 7, line 21 to page 8, line 2, Test Example 1 and Table 1 of the specification].

It can be seen from Table I that the molding sand of Additional Example A (water absorption: 0.04%) and the molding sand of Additional Example B (water absorption: 0.10%), each having a water absorption of at most 0.3% exhibit a high strength of a mold under the conditions that the amount of a binder is 0.5%, while CERABEADS #650 (water absorption: 0.45%) does not exhibit a high strength of mold, so that the molding

sand can exhibit the same level of strength of the mold under the conditions that the amount of a binder is 1.5%.

Moreover, it is described in IMONO on page 567, right column that "(3) When CERABEADS is used as a molding sand, the amount of the binder increases as compared to that of a zirconium sand, but the amount of the sand used is lowered by about 40%. For this reason, the molding sand is facilitated in handling, thereby making its cost high." As described on page 25, lines 7 to 11 of the present specification, an effect that the amount of a binder can be lowered by using the molding sand of the present invention is exhibited. On the other hand, as mentioned above, the molding sand of IMONO is a technique where the amount of a binder may be allowed to increase. Accordingly, even if IMONO and other prior art references were combined, the molding sand of the present invention is not obvious for one of ordinary skill in the art.

STATEMENT UNDER 18 U.S.C. § 1001

I hereby declare that all statements made herein of any own knowledge are true, and that all statements made on information and belief are believed to be true; and further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001, of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Mikio Sakaguchi

Mikio SAKAGUCHI

Sep. 11, 2009

Date